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Specific effects of feeding different amounts of potassium iodide and salt on the character of the wool production of breeding ewes and their lambs

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SPECIFIC EFFECTS OF FEEDING DIFFERENT AMOUNTS OF POTASSIUM IODIDE AND SALT ON THE CHARACTER OF THE WOOL PRODUCTION OF BREEDING EWES AND THEIR LAMBS.

by

Maynard Goldman Snell

A Thesis Submitted to the Graduate Faculty
for the Degree of

DOCTOR OF PHILOSOPHY

Major Subject - Animal Husbandry

Approved

Signature was redacted for privacy.

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1928

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INTRODUCTION

Just what effect has feed upon the quantity and quality of wool produced is a question which was asked more than a half a century ago. Yet, an adequate solution of the problems involved in the question is far from being attained. The climate, the soil and the feed materially affect wool production according to some of the earlier writers in animal husbandry. The comparatively recent discovery that iodine administered to the pregnant sow and ewe in goitrous districts prevents hairlessness and woollessness in new born offspring raises the question of the possible effect of iodine feeding on the character and quality of wool production, particularly in districts known to be deficient in iodine. Ames lies in a semi-goitrous region showing a mild deficiency of iodine in nutritive substances.

The problem selected for this study involves the determination of the effect of feeding varying amounts of iodine, as Potassium Iodide, also the effect of salt feeding upon the character and quality of wool production of ewes and their offspring.

REVIEW OF LITERATURE

As long ago as 1848 Youatt said: "The variations in the diameter of the wool in different parts of the fiber will also curiously correspond with the degree of heat at the time the respective portions were produced. . . . . .

"Pasture has a far greater influence on the fineness of the fleece. The staple of the wool, like every other part of the sheep, must increase in length or in bulk when the animal has a superabundance of nutriment; and on the other hand, the secretions which forms the wool decreases like every other, when sufficient nourishment is not afforded.

"When little cold has been experienced in the winter, and vegetation has been scarcely checked, the sheep yields an abundant crop of wool, but the fleece is perceptibly coarser as well as heavier. When the frost has been severe and the ground long covered--if the flock has been fairly supplied with nutriment, although the fleece may have lost in weight, it will have acquired a superior degree of fineness, and a proportional increase in value. Should, however, the sheep have been neglected and starved during this prolongation of cold weather, the fleece as well as the carcass is thinner, and though it may have preserved its smallness of filament, it has lost in weight, and strength, and usefullness."

Thus we see that one of the earlier and most prolific of the English writers on sheep production held that not only the nutrition of the animal but also weather conditions affected markedly the character and production of wool.

Views similar to these held by Youatt have been expressed in recent times. Masterdon (1926) says:

"The appearance of wool can be altered in a very short time by a change on to a different kind of soil. Both the curl and the yolk will alter. . . . . Light soils of almost any description have a tendency to grow finer and lighter fleeces. Strong heavy clay land has the opposite effect. It will grow a wool with very little crimp and a lack of character. Limestone land, where the mineral is prominent grows strong wool, hard to the feel, and with more of a twist than a curl."

Roux (1926), a student from South Africa, while attending one of the larger universities in the United States, wrote:

"The factors influencing the production of good quality wool are many: some of which may be controlled by man.

"Climatic and soil conditions may be noted as the most important, especially so far as the production of Merino wool is concerned. . . . . All other things being equal the best quality wool can be grown in a country suitable for the growth of <u>short sweet grass</u>.*. . . . .

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* The italics are the author's.

"There is no doubt that the entire fleece is affected by climatic conditions. In cold countries or the colder points of a country, the tendency will be towards density, shortness of staple, abundance of yolk or grease, increased fineness and a danger of wool becoming effeminate. Under arid conditions the staple is apt to become longer, less dense, 'stronger' or coarser, and the danger of the wool becoming harsh or unkind exists. . . . .

"Breeding and feeding have an important effect on the quality of the wool. . . ."

Another idea (Anonymous, 1923) concerning the effect of feed on wool production is contained in a popular article in a London, England, livestock journal. This writer states that growth of wool will not be affected by the feeding so long as the liveweight of the animal is maintained. Liberal feeding may give a heavier fleece but the difference was thought to be due more to increased deposition of wool fat rather than to an extra growth of wool.

The popular views and opinions, although not supported by experimental proof present an interesting background to the wool research in hand, suggestive of the possibility of finding specific nutritive factors which affect wool growth.

Craig (1896) reported five year's work of the effect of feed upon wool production. The experiment covered three periods, (a) birth to weaning, approximately from April to July, (b) weaning to fattening, approximately from July to November,

and (c) fattening stage, approximately from November to February. The total period covered about ten months.

In Craig's work, Lot I received grain from birth to marketing time; Lot II grain from weaning to market; and, Lot III grain during the fattening stage. All three groups were fed the same ration during the fattening.

The wool production of lots I, II, and III is tabulated herewith:

Lot	I	II	III
Grease wool, lbs.	8.7	7.5	7.4
Clean, lbs.	4.9	4.7	4.5
Shrinkage, pct.	43.0	37.1	38.0

Henry and Morrison (1922) state as information to the authors that Wilson and Kuhlman at the South Dakota Station increased the wool yield nine per cent. by adding linseed oil meal to a ration of corn, oats, and prairie hay. On a ration of corn, oats and alfalfa hay, the wool yield was increased sixty per cent. over the basal feeding period.

Hammond (1922) found that ewes wintered on an average daily ration consisting of corn, .63 pound, linseed oil meal, .12 pound, hay, .48 pound, and silage averaged 7.87 pounds of wool as compared to 8.23 pounds for ewes wintered on a ration consisting of corn, .40 pound, linseed oil meal, .35 pound, hay, .48 pound, and silage 3.58 pounds. The difference is primarily

one of a linseed oil meal partial substitution for corn grain plus a mild surplus of this high protein flaxseed by-product.

Curtiss (1922) in reporting the work of Evvard and Culbertson on wintering pregnant ewes states that the wool yield in a lot receiving one ounce potassium chloride per ewe daily was heavier than the check lot. The comment is added that it is barely possible that the feeding of this relatively large amount of potassium chloride may have an influence on the growth of wool from the gross weight standpoint. These experimentalists recently emphasize that these results should be taken in a suggestive sense.

Zuntz (1920) fed four sheep on straw and beets so as not to have a change in body weight. One group of two animals received daily from eight to ten grams of digestible horn in addition. After four months the fleeces of the group receiving horn showed remarkably more strength (development) than that of the other group. The microscope showed the diameter of the wool fibers to be one-third greater than that of the other animals. Each single fiber had strengthened itself considerably. It is to be emphasized that the number of animals under experiment are too meager to warrant trustworthy conclusions and hence the work is to be regarded as in the suggestive class.

Evvard and Culbertson (1924) fed different salt allowances to wintering pregnant ewes and found differences in

fleece yields. Their results are as follows:

Lot No.	Salt per ewe daily	Fleece weight at shearing time, average per ewe, lbs.
I	no salt	7.63
II	¼ oz salt	8.04
III	½ oz salt	8.52
IV	1 oz salt	7.65

The literature on iodine, especially in its relationship to goiter, is quite voluminous. To attempt a full survey is beyond the province of this paper. However, a few references are appended.

Bauman (1896) announced that iodine was a normal constituent of the thyroid gland. Marine and Kimball (1917), Kimball and Marine (1918), Kimball, Rogoff and Marine (1919), and Kimball (1922) have clearly shown that iodine is a specific for the prevention of thyroid enlargement in man.

McClendon and Hathaway (1924) have presented charts which show a remarkable coincidence between the incidence of goiter in man and the regions of low iodine content of drinking water. The regions of heaviest incidence of goiter are the areas around the St. Lawrence River valley, the Great Lakes basin, and the Northern Plain area extending from the Great Lakes to and including certain areas of the Rockies. These charts indicate Iowa to be semi-goitrous. Evvard and Culbertson (1925) found that feeding iodine to swine resulted in in-

creasing the average daily gain by 9.91 per cent. and in reducing the feed required per hundred pounds gain by ten per cent. And lastly, that Evvard (1928) gives it as his experience that no hairlessness in pigs, which could be attributed to a lack of iodine, has accured in the experimental herd of swine at the Iowa Experiment Station during the last eighteen years. On the other hand, in the Spring of 1917, forty breeding ewes produced fifty-five lambs, twenty-three of which showed noticeable thyroid enlargements. This latter is sufficient evidence to indicate that iodine deficiency is experienced in the Ames area so far as sheep production is concerned.

Russel and Morrison (1923) state that goiter in newborn lambs rarely occur when the ewes have had access to green feed during the last three months of the gestation period.

Kalkus (1920) reports death losses of lambs as high as 83 per cent. in some years in certain goitrous districts of the Northwest; the majority of losses being due to goiter, hairlessness and weakness. He observed that goiter and baldness were associated in lambs. He gives it as the experience of stockmen that it is almost impossible to raise kids in markedly goitrous districts. He states that most of the kids are hairless, some are covered with very fine hair, while others are normal; also, that there seems to be no definite and uniform relationship between the size of the thyroid, which is indicative of a deficiency of iodine, and hairlessness.

Kalkus (1920) also reported an experiment in the

control of goiter in goats. The tabulated results are as follows:

Results of Iodine Test, 1917-1918
(6 does in each lot)

Lot	Form of iodine compound	Dosage	Frequency and method of administration	Number of young born	Condition of young at birth
I	none	--	--	10	all hairless, 8 still born 2 died shortly
II	KI	2 grains in $\frac{1}{2}$ oz. water	daily during gestation period, per orem	5	all normal
III	tinct.of iodine	5 mils of 10% sol.	weekly during gestation, sub-cutaneous	7	all normal
IV	tinct.of iodine	1 mil.	weekly during gestation period	8	7 normal 1 slight throid enlargement, but well haired

METHODS OF EXPERIMENTATION.

Time and Duration of the Experiments.

These experiments covered the two winter feeding pregnancy periods during the years 1926-1927 and 1927-1928. Feeding was begun December 11th the first, and November 22nd the second winter. Potassium Iodide feeding continued so long as the ewes were pregnant. The closing date of the winter feeding pregnancy period was April 26, 1927 and April 11, 1928, respectively, for the two years.

From August 11, 1926 to July 14, 1927 the ewes received no salt as such except that included in the rations during the winter. On the later date the ewes were given access to block salt and continuously thereafter except during the winter period, 1927-1928, when no salt was allowed except that included in the ration.

Animals used. High grade Hampshire ewes were used. These ewes are the result of fifteen years grading up with purebred Hampshire rams upon a foundation of grade ewes showing considerable Merino blood.

Allotment Considerations.

In the Winter of 1926-1927 five lots of ten ewes each were selected from fifty-five ewes.

Weight, age, condition, weight of fleece, grade of wool, length of wool and the number of days pregnant were taken into consideration in alloting the ewes.

The ewes continued in these same lots during the year 1927-1928 except that one of the lots, Lot V, was dropped out and replacements, due to deaths or culling in the other lots, were made from Lot V insofar as was possible.

Rations Fed and Method of Handling.

The rations fed per ewe daily during the winter of 1926-1927 were as follows:

Lot I. Check. Grain mixture A (shelled corn--natural moisture basis--60 lbs.; whole oats, 30 lbs.; linseed oil meal, 10 lbs.; total 100 lbs.); 1 pound divided into two equal feeds; 2.7 pounds of corn silage A.M. feed; 1 pound alfalfa hay P.M. feed; and 1/2 ounce (.03125 lb.) flake salt (mixed with grain mixture).

Lot II. 1/20 grain Potassium Iodide. Same as Lot I except 1/20 grain of Potassium Iodide mixed and fed with the salt.

Lot III. 1/5 grain Potassium Iodide. Same as Lot I except 1/5 grain of Potassium Iodide mixed and fed with the salt.

Lot IV. 4/5 grain Potassium Iodide. Same as Lot I except 4/5 grain of Potassium Iodide mixed and fed with the salt.

Lot V. No salt fed. Same as Lot I except that the salt was omitted.

Lot V was omitted during the Winter of 1927-1928 otherwise the lots were handled same as in 1926-1927.

The Potassium Iodide feeding was discontinued for each ewe on the day of her parturition.

Cereal straw was used for bedding.

The ewes were allowed the run of a small paddock on dry, sunny days for exercise.

During the suckling period, 1926-1927, all ewes received a full feed of Grain Mixture A, alfalfa hay and corn silage, but no Potassium Iodide or salt. The second year, block salt, self-fed, was allowed in addition to the above ration.

Lambs. The lambs during the first sixty days after birth received corn grain, whole oats, and linseed oil meal, self-fed separately in a creep. They had free access to grain, silage and hay in the common feeding bunks. After sixty days the grain and roughage records were discontinued, the ewes and their lambs on the sixtieth day following the lambs' birth being turned into a common lot and fed on feed similar to the ones given during the two months suckling period. As soon as the blue grass pasture was available for the flock, all were turned to grass. No salt was fed in the Summer of 1927 on grass but was allowed in 1928 from birth.

Wool Samples, Ewes.

a. Initial Samples. A small wool sample 1/2"x 1/2" in area was taken from the right shoulder the day the ewes were placed into the feed lots in the fall. An area approximately

2"x 2" was then clipped close to the skin around the place from where this sample was taken.

The dates of the initial samples were December 11, 1926 and November 22, 1927 for the two years respectively.

b. Final Sample. On the closing date of the winter period, a 1/2"x1/2" sample was taken from all ewes. This sample was taken from the 2"x 2" clipped area of the previous fall.

The dates of the final samples were April 26, 1927 and April 11, 1928 respectively.

c. Scouring Samples. On the closing day of the winter period of the first year and on both the opening and closing days of the winter period of the second year, 4"x 4" samples were taken from all ewes for shrinkage determinations.

Wool Samples, Lambs.

In the Spring of 1927 1/2"x1/2" wool samples were taken from practically contiguous areas of the right shoulder of all lambs at 60 and 120 days after birth. The second spring, 1/2"x1/2" samples from the right shoulder of all lambs were taken at 60 and 100 days after birth. The taking of 100 day samples in the Spring of 1928 was necessary in order to send the lambs to the market at an earlier date than occurred the previous year.

LABORATORY STUDIES ON WOOL

Laboratory studies, involving the measuring of 41,700 wool fibers, were made on the small 1/4 square inch samples.

The samples were cleaned in groups before starting the other determinations. Following this, staple length, fiber length, crimp and average diameter of fiber were determined in order on each sample. Weighings for density determination were made by groups after all other determinations had been recorded.

Cleansing.

All samples were degreased and cleaned by immersing in a benzine bath for about two minutes.

Staple and Fiber Length.

Each sample was measured for staple length by laying it flat on a steel measure graduated into sixty-fourths of an inch. These measurements were later converted into inches, decimally expressed. Then a small bundle of fibers about the size of the lead in an ordinary writing pencil were measured for length when stretched sufficiently to take the crimp out. The second year an average of the lengths of ten fibers pulled at random from the sample, while stretched to eliminate the crimp, were them measured.

Crimp.

Ten fibers, pulled at random, were laid against a back ground so that the number of crimps in an inch section could be counted. One count was made on each fiber and a record of the diameter, fiber length and number of crimps per inch was made for each fiber measured.

Diameter of Fiber.

The diameters of one hundred fibers were taken with a Brown and Sharpe machinist's caliper, calibrated in ten-thousandths of an inch. The fibers were taken from the two edges of a sample which had been previously rolled, then folded and placed in a "V" shaped cardboard held by a paper clip. Each fiber was measured near the middle. The record was kept in the form of a frequency distribution.

Density.

The one hundred fibers measured for diameter were rolled together and stored in a capsule in the envelope containing the "1/4 square inch" sample. When the diameter measurements were completed on a group of samples, the samples were taken to a constant temperature and humidity room, the capsules were opened and the samples conditioned for four hours or more. The one hundred fibers and the total sample were weighed separately.

This procedure was used on all except the initial ewe samples of the first year's work. In this case the samples were not conditioned but weighed in weighing bottles.

The formula used for calculating density is:

$$\text{Calculated density} = 100 \frac{\text{Wt. of sample including the 100 fibers}}{\text{Wt. of 100 fibers}}$$

According to Hultz (1927) the Wyoming wool laboratory has shown an error of only 0.6 to 1.0 per cent. over actual count.

Scouring.

In the first year's work, 1926-1927, the shrinkage was

determined on a bone dry basis, the samples being dried in an oven for three hours at 105 degrees Centigrade both before and after scouring. The yield of clean wool was calculated from the weights thus secured.

In the second year's work, 1927-1928, the grease sample was weighed and then scoured. Following this the bone dry weight was determined. This bone dry weight of scoured wool times 1.16 gives the figure for the yield of clean wool. This method gives the weight of wool on a 16 per cent. moisture basis.

The scouring bath consisted of water, one liter; Ivory soap flakes, 5 grams; soda ash, 12½ grams; temperature 130 degrees Fahrenheit. The Ivory soap flakes and the soda ash were made up into two stock solutions and used so as to give the above specific amounts of these materials in the scouring bath.

Each sample was washed through three scouring liquors and three rinse waters, the latter being softened with some of the soap solution. The second scouring liquor became the first liquor for the next sample. The samples were mixed and taken at random rather than scoured by lots.

It is realized that shrinkage percentages so determined do not represent accurately the shrinkage of the whole fleece, however, they are accurate for purposes of relative comparison.

DISCUSSION OF EXPERIMENTAL RESULTS

Ewes.

Before discussing the experimental findings, it is necessary to emphasize that the two years' results are not entirely comparable. During the first year no salt was allowed the ewes except that fed in the ration during the winter period.* The lambs, this first year, received no salt from birth on.

But the second year the ewes were given free access to block salt on July 14, 1927 and continuously thereafter, except during the winter when no salt was allowed other than that contained in the ration.

This change in procedure was made because no significant differences in weight of fleeces accurred between the "no-salt" group, Lot V, and the "salt-no Potassium Iodide" group, Lot I, the first year. Consequently, it was decided not to continue this lot the second year and inasmuch as this lot was not to be continued the ewes in the other lots were allowed salt. This change in procedure does not permit the direct comparison of one year's results with the other, yet the results obtained raise important questions. These queries are pointed out in the following discussion of the experimental results.

Table I, entitled "Weights, Gains and Grease Wool Production of the Ewes", gives the average initial weights, the average daily gains and the average gross wool production of the several lots for the two years. This table shows no

*The salt was discontinued on each ewe at parturition time, or when removed from the lot because of non-pregnancy.

particularly significant differences in the average daily gain per ewe among the various lots. There is a very minor suggestion that the Potassium Iodide feeding may have influenced gains favorably. The gross weight of the wool was not appreciably altered by the treatment.

TABLE I

Weights, Gains and Grease Wool Production of the Ewes.

Lot number	I	II	III	IV	V
Lot Designation:	No KI	1/20grain KI	1/2grain KI	4/5grain KI	No Salt
	1926-1927 Winter Period, December 11, 1926 to April 20, 1927				
Number of ewes	10	10	10	10	10
Ave. number of days in winter period	98	95	97	90	96
Ave. initial wt. per ewe, lbs.	181	181	181	181	181
Ave. daily gain per ewe, lb.*	.22	.30	.30	.28	.21
Ave. grease wool production per ewe, lbs.	8.44±.17	8.16±.15	8.35±.23	7.89±.28	8.16±.27
	1927-1928 Winter Period, November 22, 1927 to April 11, 1928				
Number of ewes	10	10	10	10	
Number of days on experiment	111	116	117	116	
Ave. initial wt. per ewe, lbs.	183	184	190	177	
Ave. daily gain per ewe, lb.*	.20	.20	.13	.22	
Ave. grease wool production per ewe, lbs.	7.94±.31	7.84±.18	8.63±.38	7.83±.33	

*To last weight immediately previous to lambing.

Table II, entitled "Yield of Clean Wool, of the Ewes,

Estimated", giving the average estimated clean yield of wool for the two years, shows no outstanding significant effect of Potassium Iodide or salt feeding on the yield of clean wool. A comparison between lots, one year with another, also shows no conspicuous effect of treatments on the estimated yield of clean wool.

TABLE II

Yield of Clean Wool of the Ewes, Estimated*.
(Yield in Pounds)

Lot	Mean	Probable error	Basal Lots for Comparison with Succeeding Lots: I — Difference	I — Probable error of difference	II — Difference	II — Probable error of difference	III — Difference	III — Probable error of difference	IV — Difference	IV — Probable error of difference
					1926-1927					
I	5.41	.20								
II	5.37	.13	-.04	.24						
III	5.33	.20	-.08	.28	-.04	.24				
IV	5.26	.16	-.16	.25	-.12	.20	-.08	.25		
V	5.07	.22	-.34	.30	-.30	.26	-.26	.30	-.18	.27
					1927-1928					
I	5.01	.35								
II	4.59	.33	-.42	.36						
III	4.78	.23	-.23	.42	±.19	.26				
IV	4.80	.29	-.21	.45	±.21	.31	±.02	.37		

*Percentages given in Table III applied to gross fleece weights of Table I give the yield figures.

The percentage wool yield, or in inverse terms, the shrinkage, is shown in Table III, entitled "Percentage Yield of Clean Wool of the Ewes". Lots II and III, both Potassium Iodide fed lots, in the 1926-1927 series, show an increase

in yield over this check, Lot I, receiving no Potassium Iodide. But, Lot V, the "no salt" lot, when compared to Lot I showed a decrease in estimated clean yield.

In the 1927-1928 series, lots II, III and IV, the Potassium Iodide fed lots, showed a decrease in estimated yield of clean fleece.

It appears that Potassium Iodide feeding had some influence in decreasing the percentage yield of fleece wool of the ewes in the 1927-1928 season, inasmuch as we have a partially progressive decrease in both the percentage yield determined for April 11, 1928 fleeces and the differences in percentage yield, from November 22nd to April 11, 1928. The biometrical figures may be interpreted as suggestive of the influence as stated. It is to be emphasized that this apparent effect of the Potassium Iodide allowance in 1927-1928 was manifest during a period of salt feeding. The question naturally arises: Does the Potassium Iodide administration affect the "yolk" formation in the same way when salt is liberally fed throughout (1927-1928) as when the salt is discontinued some weeks prior to the sampling (1926-1927)? In the earlier year, the influence under discussion was practically nil, suggesting that the salt along with the Potassium Iodide feeding may be a necessary adjunct in the production of such an implied effect.

TABLE III

Percentage Yield of Clean Wool of the Ewes.

Lot	Mean	Probable error	Basal Lots for Comparison with Succeeding Lots: I Difference	I Probable error difference	II Difference	II Probable error difference	III Difference	III Probable error difference	IV Difference	IV Probable error difference
				1926-1927						
I	63.75	.97	?							
II	65.30	.94	±1.73	1.35						
III	63.62	2.12	± .05	2.35	-1.68	2.32				
IV	66.35	.84	±2.78	1.28	±1.05	1.26	±2.73	2.28		
V	61.35	1.22	-2.22	1.56	-3.95	1.54	-2.27	2.72	-5.00	1.51
				1927-1928						
I	61.45	2.50								
II	57.84	1.00	-3.61	-2.69						
III	54.70	1.32	-6.75	2.79	-3.14	1.71				
IV	59.80	1.68	-1.65	3.01	±1.96	1.95	±5.10	2.13		

Fleece samples from all ewes were taken on the opening and closing days of the winter period of the 1927-1928 series for the purpose of determining the change occurring, if any, in the percentage yield, or inversely, the shrinkage, of the wool in the several lots during the winter period. These results are tabulated in Table IV, entitled "Changes in Percentage Fleece Yield of the Ewes, 1927-1928 Only".

The United States Sheep Experiment Station (1924) at Dubois, Idaho, has shown long fine-wool fleeces to have a higher percentage clean content of wool than similar but shorter stapled fleeces. Curiously enough, this one year's results shows the opposite effect in the three Potassium Iodide fed lots. These lots all show a decrease in percentage yield of shoulder

samples taken in the spring at the end of the winter feeding period as compared to those taken on the opening date the fall before. This indicates that the shrinkage increased over this period, particularly so since the check lot, not fed Potassium Iodide, showed an arithmetical increase.

TABLE IV

Changes in Percentage Fleece Yield of the Ewes
1927-1928 Only

(Based on 4"x4" shoulder samples.)

	Initial April 26, 1927 to November 22, 1927		Final November 22, 1927 to April 11, 1928			
Lot	Yield Percentage	Probable Error	Yield Percentage	Probable Error	Mean Difference	Probable Error
I	61.19	.86	61.45	2.50	+.26	2.64
II	58.35	.80	57.84	1.00	-.52	1.24
III	60.45	1.87	54.70	1.32	-5.76	2.32
IV	63.19	1.81	59.80	1.68	-3.40	1.33

Table V, entitled "Fineness of Fibers from Fleeces of Ewes", tells the story of the differences in the average diameter of the wool fiber grown before and during the winter period.

Every ewe, during the winter period of 1926-1927 produced wool in the 2"x 2" shorn space on the right shoulder with a smaller average diameter than was produced in the same space prior to and after shearing that fall.

The ewes in Lot V, which received no salt, showed the greatest reduction in average size of fiber, while Lot I, receiving salt but no Potassium Iodide, showed the least reduction

in this respect. The size of fiber in the Potassium Iodide fed lots, although showing a greater average reduction than in Lot I, decreased less in average size of fiber than did Lot V.

The 1927-1928 results, so far as diameter of fiber in the ewes is concerned, were similar to those of 1926-1927. The average diameter of fiber of every ewe, without a single exception, decreased in size both years.

The ewes in Lot II, receiving one-fifth grain of Potassium Iodide daily showed a reduction of 2.07 ten-thousandths of an inch followed by the ewes in Lot IV, with a reduction of 1.41. Lot III showed the smallest decrease in average size of fiber of any of the lots, this figure being 1.41.

The Potassium Iodide feeding in every different comparison but one (Lot III, 1927-1928) showed an effect in increasing the fineness of the fiber. In this one exception it is possible that the Potassium Iodide feeding of the previous year maybe to some extent responsible for the rather fine initial fiber (8.86) in the second year; this deduction being in line with both the Lots III and IV, receiving the most Potassium Iodide in 1926-1927, showed the least diameter of any of the initial groups of both years.

Everything considered, it is our interpretation that Potassium Iodide feeding tended to increase the fineness of fiber in the ewe flocks to which fed.

Statistically the salt feeding significantly decreased

the diameter of fibers (Lot I compared to Lot V) but the elimination of salt (Lot V) from the salt-heavy Potassium Iodide group (Lot IV) did not have a significant effect in the same direction, indicating that the iodide feeding had considerable refining influence, this masking the salt feeding factor to a large extent. This reasoning further bears out our opinion that the feeding of Potassium Iodide is favorable to the production of fineness in the wool fibers of the ewes injesting same.

TABLE V

Fineness of Fibers from Fleeces of the Ewes

(Diameter of fibers in ten-thousandths of an inch.)

Lot	Initial Sample: Ave. diameter fiber	Initial Sample: Probable error	Final Sample: Ave. diameter fiber	Final Sample: Probable error	Mean difference	Probable error difference	Basal Lots for Comparison with Succeeding Lots: I: Change due to variation	I: Probable error change	II: Change due to variation	II: Probable error change	III: Change due to variation	III: Probable error change	IV: Change due to variation	IV: Probable error change
					--	1926-1927	--							
	May 11 to Oct. 16, 1926		Dec. 11, '26 to Apr. 26, '27											
I	10.23	.041	8.71	.040	-1.52	.11								
II	9.45	.035	7.67	.034	-1.78	.24	.26	.26						
III	9.86	.040	8.06	.036	-1.80	.24	.28	.26	.02	.34				
IV	10.11	.038	8.33	.036	-1.79	.21	.27	.24	.01	.32	.01	.32		
V	9.59	.040	7.48	.040	-2.11	.13	.59	.17	.27	.31	.31	.27	.32	.25
					--	1927-1928	--							
	Apr. 26 to Nov. 22, 1927		Nov. 27, '27 to Apr. 11, 28											
I	9.49	.035	7.70	.040	-1.80	.21								
II	9.28	.030	7.21	.026	-2.07	.08	.27	.22						
III	8.86	.034	7.45	.039	-1.41	.14	.39	.26	.66	.16				
IV	9.05	.035	7.11	.035	-1.93	.14	.13	.26	.14	.16	.52	.20		

Table VI entitled, "Crimp of Fibers from Fleeces of the Ewes", gives the average crimp per inch of the wool produced by the ewes prior to and during the winter period.

This table shows that the wool produced during the winter period of 1926-1927 had a larger average number of crimps per lot than did the wool produced in these 2"x 2" spaces prior to this period.

The opposite results were secured the second year. Lot I showed an insignificant change, while Lots II, III and IV average decreases in number of crimps for the wool which was produced during the feeding period. These changes in Lots II and III approach significance.

TABLE VI

Crimp of Fibers from Fleeces of the Ewes

Lot	Initial Sample: Ave. crimp per inch	Initial Sample: Probable error	Final Sample: Ave. crimp per inch	Final Sample: Probable error	Mean difference	Probable error difference	Basal Lots for Comparison with Succeeding Lots: I: Change due to variation	I: Probable error change	II: Change due to variation	II: Probable error change	III: Change due to variation	III: Probable error change	IV: Change due to variation	IV: Probable error change
						-- 1926-1927 --								
	(May 11 to Oct.16,1926)		(Dec.11,'26 to Apr.26,'27)											
I	9.07	.185	10.20	.156	± 1.13	.34	.20							
II	10.09	.201	11.42	.154	± 1.33	.67	.84	.75						
III	9.89	.214	10.94	.168	± 1.05	.45	.08	.56	.28	.81				
IV	8.86	.155	9.58	.167	± .72	.22	.41	.40	.61	.71	.33	.50		
V	10.16	.176	10.76	.182	± .60	.22	.09 .53	.40	.73	.71	.45	.50	.12	.31
						-- 1927-1928 --								
	(Apr. 26 to Nov.22,1927)		(Nov.27,'27 to April 11,'28)											
I	8.92	.181	9.01	.144	± .09	.22								
II	9.80	.147	9.30	.130	- .64	.19	.73	.29						
III	9.72	.147	8.98	.129	- .72	.38	.81	.44	.08	.42				
IV	9.71	.157	9.33	.121	- .38	.34	.47	.41	.26	.39	.34	.51		

The lot average staple and average fiber lengths of the wool produced by the ewes prior to and during the winter periods is shown in Table VII, entitled "Growth of Fleece of Ewes".

This table shows, for the year 1926-1927, no significant differences between lots, neither in average staple lengths nor average fiber lengths of wool prior to the beginning of the winter period. Also, the average staple lengths and average fiber lengths for the wool produced during the winter feeding period showed no significant differences.

The ewes in the 1927-1928 series showed greater differences in average staple length of wool produced prior to the beginning of the winter period than did the ewes in the previous trial.

The differences in average fiber length were even greater than in average staple length over this period but the order of the lots remained unchanged.

The ewes in Lot III prior to the winter period averaged shorter in both staple and fiber lengths than did the ewes in any other of the lots. It is perhaps worthwhile to call attention to the fact that these same ewes produced, during the winter period, fleeces which averaged longer in each of these respects than did the ewes in the other three lots.

The average fiber lengths of the wool produced by the several lots during the winter feeding period of 1927-1928

showed no significant differences.

TABLE VII

Growth of Fleece of Ewes

Lot	Staple length inches	Probable error	Fiber length inches	Probable error	Staple length inches	Probable error	Fiber length inches	Probable error
	1926-1927							
	(May 11 to October 16,1926)				(Dec. 11,1926 to Apr.26,1927)			
I	1.70	.08	2.15	.09	1.17	.06	1.48	.07
II	1.78	.08	2.20	.11	1.13	.03	1.43	.02
III	1.69	.07	2.05	.08	1.13	.02	1.43	.02
IV	1.71	.08	2.14	..07	1.11	.03	1.38	.06
V	1.83	.06	2.16	.06	1.11	.03	1.40	.04
	1927-1928							
	(Apr.26,1927 to Nov.22,1928)				(Nov.22,1927 to Apr.11, 1928)			
I	2.26	.10	3.26	.11	1.21	.05	1.93	.05
II	2.11	.06	3.10	.08	1.29	.03	1.92	.04
III	1.96	.08	2.92	.05	1.33	.04	2.00	.04
IV	2.19	.09	3.04	.08	1.21	.03	1.99	.05

The effect of the various rations upon the density of the ewe fleeces is shown in Table VIII, entitled "Density and Change in Density of Fleece of Ewes".

In the 1926-1927 series, the lot average densities of the fleece produced during the winter period w as not significantly different from the fleece produced prior to this time. But the second year, the wool produced during the winter period showed a marked increase in the calculated number of fibers per one-fourth square inch, this increase being highly significant in Lots I, II and III, and approaching significance in Lot IV.

TABLE VIII

Density and Change in Density of Fleece of Ewes.

Lot	1926-1927 Initial Sample: Fibers per 1/4 sq. inch	Probable Error	1926-1927 Final Sample: Fibers per 1/4 sq. inch	Probable Error	Difference: Mean	Probable Error
	May 11 to Oct. 10, 1926		Dec. 11, 1926 to April 26, 1927			
I	3,003	167	2,785	122	-221	217
II	3,426	151	~~2,878~~ 2,922	149	-504	253
III	3,240	159	3,479	22	242	162
IV	3,289	117	3,133	178	-156	162
V	3,259	155	3,841	175	~~547~~ 582	176
	1927-1928 April 26 to November 22, 1927		1927-1928 November 27, 1927 to April 11, 1928			
I	3,943	258	5,982	240	2,039	342
II	3,447	225	5,857	166	2,410	253
III	3,080	121	5,344	203	2,264	242
IV	3,732	259	4,581	190	849	361

Lambs.

The diameter of fibers of the lamb fleeces is shown in Table IX, entitled, "Fineness of the Fleeces From the Lambs", while the change in diameter of fibers is shown in Table X, entitled, "Changes in Fineness of Fibers from Fleeces of Lambs". For the first years results, these tables show the lot averages of the fleeces of the lambs from the Potassium Iodide fed ewes to be distinctly less than that of Lot I lambs, these differences being highly significant statistically.

The fleeces of the Lot V, "no-salt" and "no-Potassium Iodide" fed lambs, when compared to the fleeces of the check lot showed a decrease in the average size of fiber but not as great a decrease as accured in lambs from the Potassium Iodide fed ewes. However, this decrease is highly significant from a statistical standpoint, being 6.3 time its probable error.

The 120-day samples (see Table X) showed no change in the order of the lots as regards fineness, but in every case the average diameter had increased significantly. The greatest average increase in this respect was from the lambs whose mothers received no salt. The least gain occurred in Lot I, whose mothers received salt but no Potassium Iodide.

The second year's results also showed the Potassium Iodide fed lambs to average finer in fiber at 60 days. But at 100 days, the fleeces from the lambs in Lot III, whose mothers received one-fifth grain of Potassium Iodide daily, averaged larger in diameter of fiber than did the fleeces of the check lot lambs. The Lot IV lambs, on the other hand, averaged much finer in fiber than did the Lot I lambs.

The increase in size of fiber from 60 to 100 days was not as marked in proportion as was the increase from 60 to 120 days in the previous year's results. Nor were the changes as consistent. Two lots, Lots II and III, showed a greater average increase in size of diameter than did the check lot lambs. But the Lot IV lambs, on the other hand, as compared to the Lot

I lambs, showed an insignificantly smaller average increase. It should be remembered, however, that the lambs in the second year's work received salt, self-fed, from the time of birth on.

TABLE IX

Fineness of Fiber from Fleeces of the Lambs

(Diameter of Fibers in ten-thousandths of an inch)

Lot	Average Diameter	Probable error	Basal Lots for Comparison with Succeeding Lots: I Difference	I Probable error of difference	II Difference	II Probable error of difference	III Difference	III Probable error of difference	IV Difference	IV Probable error of difference
				1926-1927						
				At 60 days of age.						
I	8.52	.04								
II	7.96	.03	.56	.05						
III	7.98	.04	.54	.06	.02	.05				
IV	7.95	.03	.57	.05	.01	.04	.03	.05		
V	8.14	.04	.38	.06	.18	.05	.16	.06	.19	.05
				At 120 days of age.						
I	9.57	.04								
II	8.84	.03	.73	.05						
III	8.89	.04	.68	.06	.05	.05				
IV	8.92	.03	.65	.05	.08	.04	.03	.05		
V	9.41	.04	.16	.06	.57	.05	.52	.06	.49	.05
				1927-1928						
				At 60 days of age.						
I	7.01	.03								
II	6.53	.03	.48	.04						
III	6.65	.05	.36	.06	.12	.06				
IV	6.64	.04	.37	.05	.11	.05	.01	.06		
				At 100 days of age.						
I	7.37	.03								
II	7.22	.04	.15	.05						
III	7.43	.05	.06	.06	.21	.06				
IV	6.88	.04	.49	.05	.34	.04	.55	.06		

TABLE X

Change in Fineness of Fibers from Fleeces of Lambs.

Lot	1926-1927 60-day Sample Diameter of fiber	60-day Sample Probable error	120-day Sample Diameter of fiber	120-day Sample Probable error	Change Mean	Change Probable error
I	8.52	.04	9.57	.04	1.52	.11
II	7.96	.03	8.84	.03	1.78	.24
III	7.98	.04	8.89	.04	1.80	.24
IV	7.95	.03	8.92	.03	1.79	.21
V	8.14	.04	9.41	.04	2.11	.13
	1927-1928					
	60-day Sample		100-day Sample			
I	7.01	.03	7.37	.03	.36	.13
II	6.53	.03	7.22	.04	.68	.11
III	6.65	.05	7.43	.05	.78	.13
IV	6.64	.04	6.88	.04	.24	.20

The crimp of the lamb fleeces is shown in Table XI, entitled "Crimp of Lamb Fleeces".

The sixty-day results of the first year's work show two of the Potassium Iodide lamb lots II and II to have, on the average, fewer crimps per inch than fleeces from the check lot lambs. The salt-heavy Potassium Iodide Lot IV lambs, however, had a greater number of crimps per inch. The "no-salt" Lot V lambs likewise had on the average a greater number of crimps per inch.

Except for Lot III, the relative positions of the lots as regards crimp per inch, had not changed.

In the second year's work, the no-Potassium Iodide lambs, Lot I, had crimpier fleeces than did the Potassium Iodide

fed lambs of the other three lots. At 100 days, the Lot I lambs still had crimpier fleeces than the other lambs, excepting the heavy Potassium Iodide fed lambs of Lot IV.

TABLE XI

Crimp of Lamb Fleeces.

Lot	Average crimps per inch	Probable error	Basal Lots for Comparison with Succeeding Lots: I Difference	I Probable error difference	II Difference	II Probable error difference	III Difference	III Probable error difference	IV Difference	IV Probable error difference
					1926-1927					
					At 60 days of Age.					
I	7.69	.09								
II	7.67	.11	.02	.14						
III	7.16	.11	.53	.14	.51	.16				
IV	8.23	.11	.54	.14	.56	.16	1.07	.16		
V	8.04	.12	.35	.15	.37	.16	.88	.16	.19	.16
					At 120 days of Age.					
I	8.89	.10								
II	8.54	.10	.35	.14						
III	9.09	.09	.20	.13	.55	.13				
IV	9.15	.10	.26	.14	.61	.14	.06	.13		
V	8.67	.10	.22	.14	.13	.14	.42	.13	.48	.14
					1927-1928					
					At 60 days of Age.					
I	8.35	.11								
II	7.55	.10	.80	.15						
III	7.35	.15	1.00	.19	.20	.18				
IV	7.73	.10	.62	.15	.18	.14	.38	.18		
					At 100 days of Age.					
I	8.35	.09								
II	7.84	.09	.51	.13						
III	7.88	.10	.47	.13	.04	.13				
IV	8.68	.10	.33	.13	.84	.13	.80	.14		

Table XII, entitled "Change in Crimp of Lamb Fleeces", shows the change in the average number of crimps per inch of

the lamb fleeces at different ages. In the first year's results, the average number of crimps per inch increased from 60 to 120 days. The second year's results corroborate that of the first year in that three lots showed an increase in the average number of crimps per inch, but the increases were neither as large nor as significant statistically.

TABLE XII

Change in Crimp of Lamb Fleeces.

Lot	1926-1927					
	60-day Sample		120-day Sample		Change	
	Average crimps per inch	Probable error	Average crimps per inch	Probable error	Mean	Probable error
I	7.69	.09	8.89	.10	1.90	~~.26~~ .24
II	7.67	.11	8.54	.10	1.16	.22
III	7.16	.11	9.09	.09	1.73	.20
IV	8.23	.11	9.15	.10	.68	.20
V	8.04	.12	8.67	.10	1.36	.44
	1927-1928					
	60-day Sample		100-day Sample			
I	8.35	.11	8.35	.09	.00	.18
II	7.55	.10	7.84	.09	.29	.16
III	7.35	.15	7.88	.10	.53	.25
IV	7.73	.10	8.68	.10	.95	.20

The staple and fiber lengths for the lamb fleeces are shown in Table XIII, entitled "Staple and Fiber Lengths for Fleeces of the Lambs". This table shows very little difference in the average staple and fiber lengths at 60 and 120 days between the first four lots for the first year. This indicates that feeding Potassium iodide to the pregnant mothers had very

little effect upon the growth of the lambs' wool in this trial up to the time samples were taken.

The second year the differences between lots as regards average staple and average fiber lengths were greater than in the previous year. In the case of staple length, the Lot I lambs were shorter than the Lot II and Lot III lambs. The same was true for the fiber lengths. On the other hand, the Lot IV lambs averaged shorter in both average staple and average fiber lengths than did the Lot I lambs.

These facts indicate that the feeding of Potassium Iodide in the amounts fed to Lots II and III, one-fifth and four-fifths of a grain respectively, may have had a beneficial effect on growth of the wool fiber while the administration of the larger quantity, four-fifths of a grain daily, to the Lot IV ewes, resulted in a detrimental effect. If such is the case, it is not out of the realm of possibility that part of this increase or decrease in length might have been produced in part in utero.

TABLE XIII

Staple and Fiber Lengths for Fleeces of the Lambs.

Lot	1926-1927 Staple: 60-day Sample Growth in inches (ave.)	60-day Sample Probable error	120-day Sample Growth in inches (ave.)	120-day Sample Probable error	Mean difference	Probable error	1926-1927 Fiber: 60-day Sample Growth in inches (ave.)	60-day Sample Probable error	120-day Sample Growth in inches (ave.)	120-day Sample Probable error	Mean difference	Probable error
I	.88	.047	1.48	.046	.60	.040	1.08	.046	1.75	.051	.68	.022
II	.92	.020	1.53	.036	.61	.026	1.05	.023	1.88	.052	.83	.064
III	.90	.032	1.55	.045	.64	.036	1.10	.028	1.84	.047	.75	.040
IV	.92	.017	1.46	.047	.54	.036	1.11	.030	1.69	.053	.57	.032
V	.99	.012	1.48	.029	.49	.077	1.15	.015	1.78	.045	.65	.027

Lot	1927-1928 Staple: 60-day Sample Growth in inches (ave.)	60-day Sample Probable error	100-day Sample Growth in inches (ave.)	100-day Sample Probable error	Mean difference	Probable error	1927-1928 Fiber: 60-day Sample Growth in inches (ave.)	60-day Sample Probable error	100-day Sample Growth in inches (ave.)	100-day Sample Probable error	Mean difference	Probable error
I	.88	.027	1.32	.028	.44	.023	1.19	.030	1.77	.048	.57	.032
II	.94	.031	1.49	.046	.56	.038	1.26	.046	1.93	.050	.67	.035
III	.96	.028	1.40	.026	.44	.029	1.42	.030	1.94	.016	.52	.022
IV	.86	.020	1.36	.047	.50	.058	1.20	.032	1.80	.050	.59	.044

The calculated lot average fleece densities of the lambs are shown in Table XIV, entitled "Density of the Fleeces of the Lambs". Neither the average differences between lots at 60 and 120 days for the year 1926-1927, nor the average differences between lots for the 60 and 100 day sample appear significant, provided the test of significance of difference be that of three times the probable error.

TABLE XIV

Density of the Fleeces of the Lambs

Lot	Average density	Probable error	Basal Lots for Comparison with Succeeding Lots: I Difference	I Probable error of difference	II Difference	II Probable error of difference	III Difference	III Probable error of difference	IV Difference	IV Probable error of difference
				1926-1927						
				At 60 days of age.						
I	3,713	234								
II	3,300	100	-413	254						
III	2,819	153	-894	279	-481	182				
IV	3,380	142	-333	274	+80	174	+561	361		
V	4,149	332	+436	406	+849	547	+1330	375	769	362
				At 120 days of age.						
I	3,215	113								
II	3,110	153	-105	191						
III	3,103	198	-112	228	7	251				
IV	3,008	76	-207	136	-102	171	- 95	163	-441	
V	2,567	141	-648	180	-543	208	-536	125	-482	160
				1927-1928						
				At 60 days of age.						
I	4,528	149								
II	4,261	111	-267	186						
III	4,881	185	+353	238	+620	215				
IV	4,732	152	+204	213	+471	188	-149	239		
				At 100 days of age.						
I	4,231	160								
II	4,594	208	+363	264						
III	4,777	319	+546	357	+183	380				
IV	4,117	156	-114	264	-477	260	-660	355		

The change in average fleece density between 60 and 120 days and 60 and 100 days, for the first and second years, respectively, is shown in Table XV, entitled "Change in Fleece Density of Lambs".

No significant changes occurred in average density from 60 to 120 days the first year, except in fleeces from the Lot V lambs. This lot showed a significant decrease in density of 1452 ± 411 fibers. In this connection, it should be remembered that the mothers of these lambs had not received any salt since the previous August and the lambs too had not received any salt.

TABLE XV

Change in Fleece Density of the Lambs

Lot	1926-1927					
	60-day Sample		120-day Sample		Difference	
		Probable error		Probable error	Mean difference	Probable error
I	3,713	234	3,216	113	-497	221
II	3,300	100	3,110	153	-191	193
III	2,819	153	3,103	198	286	518
IV	3,380	142	3,009	76	-371	147
V	3,979	417	2,527	141	-1452	411
	1927-1928					
	60-day Sample		100-day Sample			
I	4,528	149	4,231	160	-297	156
II	4,261	111	4,594	208	333	233
III	4,881	185	4,777	319	-104	108
IV	4,732	152	4,117	156	~~-615~~ -612	116

SUMMARY

1. Potassium Iodide was fed in three different amounts to ewes during two winters to determine the effect on the growth and character of the wool produced on both the ewes and their lambs. Salt was withheld from one group of ewes the first winter with the same object in mind.

2. The influence of Potassium Iodide feeding on the ewes' wool was as follows:

(a) No change in gross yield.

(b) Percentage yield of clean wool decreased in second year, the only one in which this determination was made.

(c) Diameter unaffected by the treatment.

(d) Crimp practically unchanged.

(e) Staple and fiber lengths not significantly altered.

(f) Density of fleece unaltered first year, but significantly increased second year.

3. The influence of salt feeding on the ewes' wool was as follows:

(a) No effect on the gross wool production.

(b) No effect on the percentage yield of clean wool.

(c) Staple and fiber lengths were not significantly changed.

(d) Density of fleece unaltered.

4. The influence of feeding Potassium Iodide to pregnant ewes upon the fleeces of the lambs was as follows:

(a) Decreased the diameter of fiber at 60 days both years, at 120 days, 1926-1927, and at 100 days, 1927-1928.

(b) Crimp not materially altered.

(c) The length, staple and fiber not significantly affected.

(d) No significant change in density.

5. The influence of feeding salt to pregnant ewes upon the wool production of their lambs was as follows:

(a) The absence of salt decreased the diameter of fiber but not to the extent resulting from Potassium Iodide feeding.

(b) Crimp not changed significantly.

(c) The growth of wool, both staple and fiber, not significantly affected.

(d) The absence of salt produced a significant decrease in density from 60 to 120 days.

6. The following changes were manifest during the experiment:

(a) Finer wool was produced by every ewe in a 2"x2" shorn space during the winter period than was produced on this area during the summer.

(b) The density of the ewe fleeces increased sig-

nificantly during the winter period of 1927-1928.

(c) The initial diameter of fiber of the lamb fleeces taken at 60 days was increased at 120 days, 1926-1927, and at 100 days, 1927-1928.

CONCLUSIONS

The conclusions concerning the feeding of Potassium Iodide and salt to wintering ewes may be stated briefly as follows:

1. The feeding of Potassium Iodide to ewes did not significantly affect the diameter, the crimp, or the rate of growth of the wool fiber, or the density of the ewe fleece.

2. A decrease in percentage yield during the period of Potassium Iodide administration was noted for the one year this determination was made.

3. Potassium Iodide administration to pregnant ewes resulted in a significant increase in the fineness of the lamb fleeces, at 60 and 120 days for the year 1926-1927, and at 60 and 100 days for the year 1927-1928. Other fleece characters, crimp, length and density, of the lamb fleeces, were not materially affected.

4. The inclusion of salt in the rations did not materially affect the fineness, crimp, length, or density of the ewe fleeces. The lack of salt, however, caused an increase in fineness of fiber and a decrease in density from 60 to 120 days but no other significant changes in lamb fleeces.

5. An absence of salt in the ration of the pregnant mother and in that of the lamb resulted in an increase in fineness of fiber but not as great an increase in this respect as the administration of Potassium Iodide. A decrease in fleece

density from 60 to 120 days was also observed. Crimp and length were not affected by the absence of salt.

6. Finer wool was produced by all ewes in a 2"x 2" shorn space during the winter months than was produced on this area during the summer.

7. The ewe fleeces in all lots increased significantly in density the second year.

The initial diameter of fiber of the lamb fleeces was significantly increased at 120 days, 1926-1927, and at 100 days, 1927-1928.

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